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105 MM HEAT AMMUNITION****Philip M. Howe****March 1985****APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.****US ARMY BALLISTIC RESEARCH LABORATORY  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This special publication describes the construction and use of a rack for the temporary storage of 105 mm tank ammunition in densely populated areas, consistent with explosive safety criteria. The rack, when properly fabricated and barricaded, reduces the blast distance for inhabited buildings and the hazardous fragment distance to 50 feet. Approval for siting must be obtained, through channels, from the DOD Explosives Safety Board. It is intended that this document be used for construction guidance and as part of the documentation required for site approval.		

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## I. INTRODUCTION

The purpose of this report is to outline requirements for construction of a rack which can be used for temporary storage of M456 heat ammunition and other 105 mm tank ammunition in congested areas, consistent with DOD explosives safety criteria.

## II. BACKGROUND

Reference is made to DOD 6055.9STD, DOD Ammunition and Explosives Safety Standards<sup>1</sup> and AR 385-64, Ammunition and Explosive Safety Standards,<sup>2</sup> which implements the Department of Defense Standards. Reference is also made to Ballistic Research Laboratory Memorandum Report entitled "Temporary Tank Ammunition Storage Facility"<sup>3</sup> (in press).

Quantity-distance (Q-D) criteria for storage of conventional ammunition are designed to provide an appropriate level of protection against blast and fragment hazards. Explosives safety distance tables prescribe necessary separations and specify maximum quantities of the various classes of explosives permitted in any one location. These tables reflect acceptable minimum criteria for storage and handling of explosives. Such criteria provide reasonable safety within specified limits compatible with the risks of accidental explosion. Both the DOD 6055.9STD and the AR which implements this standard for Army installations and activities provide the opportunity for reduced hazard distances corresponding to reduced fragment and blast hazards, if it can indeed be demonstrated that the hazards are reduced. The burden of proof is upon the initiating activity to demonstrate an acceptable level of safety, however.

## III. RATIONALE

The design of this storage rack was predicated upon the assumption that the rack should control explosion size, thus limiting the maximum credible event to some small fraction of the total stores, and should also control fragment hazards. The rack specified herein limits the maximum credible event to explosion or detonation of one warhead, with a corresponding blast radius (inhabited building distance) of 50 feet. With a 6 inch sand cover (as provided by one layer of sandbags), on the sides and roof, and with front and rear barricades, primary fragments are contained completely, kickouts are reduced to a minimum, and the fragment hazard radius, based upon one hazardous fragment per 600 square feet, is also less than 50 feet. Thus, when 105 mm M456 HEAT ammunition and other nonexplosive conventional antitank ammunition are stored, in their fiber shipping tubes, in the rack, warheads facing to the rear of the rack, the appropriate hazard distance is 50 feet, regardless of the total number of rounds stored at one site.

<sup>1</sup> DOD 6055.9STD, DOD Ammunition and Explosives Safety Standards, July 1984.

<sup>2</sup> AR 385-64, Ammunition and Explosive Safety Standards.

<sup>3</sup> Philip M. Howe and David L. Collis, "Temporary Tank Ammunition Storage Facility," BRL-MR-3424 (in press).

#### IV. RACK DESCRIPTION

A shop drawing of the rack is shown in Figure 1. The rack consists of a steel frame made of angle iron, welded or bolted together, and steel spacer rods welded or bolted in position to hold the fiber tubes. The depth of the rack should be at least 45 inches deep, so that the complete round is contained within the rack. Spacing between tiers (vertical) must be at least 10 inches. Steel spacers must be positioned as in Figure 1, with separations of 6 inches, center to center, alternating with spacings of 3 inches, center to center. The support rods on 3 inch centers locate the shipping tubes with respect to each other. On the top of the rack, angle iron or rebar roof supports may be welded in place, as in Figure 1. A sheet of corrugated steel or fiberglass can be used as a rain cover and as a support for the sand cover. A sand cover of one sand bag thickness or 6 inches of loose sand is adequate for fragment protection. Note that cinder blocks, bricks, and concrete blocks are not acceptable for this application, as they serve as a source of secondary hazardous fragments. Sides of the structure are to be barricaded with a minimum of 6 inches of sand (one sandbag thickness), with the barrier joining the roof in such a way that continuous fragment protection is provided. If a natural barricade such as a berm or bank is not located behind the rack, then a sand barrier at least 3 feet thick will be placed behind the rack. The barricade may be placed in contact with the rack or it may be placed an arbitrary distance from the rack. If access to the rear of the rack is desired, a walkway space of at least 32 inches between the rack and rear barrier should be provided. In front of the rack, a barricade of sandbags (6 inches thick), cinder blocks, railroad ties, or other materials must be erected to provide protection from kickouts. The distance of this barricade from the front of the rack may be chosen for operational convenience. The minimum height of both the front and rear barricades must be equal to the top of the rack. An additional foot of height is required for both front and rear barricades for each yard of separation. Breadth of the rack is unlimited. The topmost tier of rounds shall not be more than 79 inches center of the round to ground to insure standing functional reach. This results in a round to round surface separation of 3 inches, which is sufficient to prevent round to round propagation of detonation. Significant deviations in design require approval by the DOD Explosives Safety Board. The rack, with sand covers and side barriers in place, is shown in Figure 2a. Several collocated racks are shown in Figure 2b. Note that the hazard radii are still 50 feet for the larger configuration.

#### V. USE OF THE RACK

The rack may be used to provide temporary storage of 105 mm tank ammunition, provided the rack is configured as described above, the ammunition is stored in the original shipping tubes, and the tubes are placed in the racks such that the warheads face towards the rear of the rack, provided the rack is located in excess of 50 feet from the nearest inhabited building, and provided express approval for siting is obtained from the DOD Explosives Safety Board.

#### ACKNOWLEDGEMENTS

This work was sponsored by the DOD Explosives Safety Board. The final rack design was engineered by members of the US Army Human Engineering Laboratory's HELFAST Team, led by Mr. John D. Waugh. The shop drawing was prepared by members of the Engineering Design Division, USAHEL.

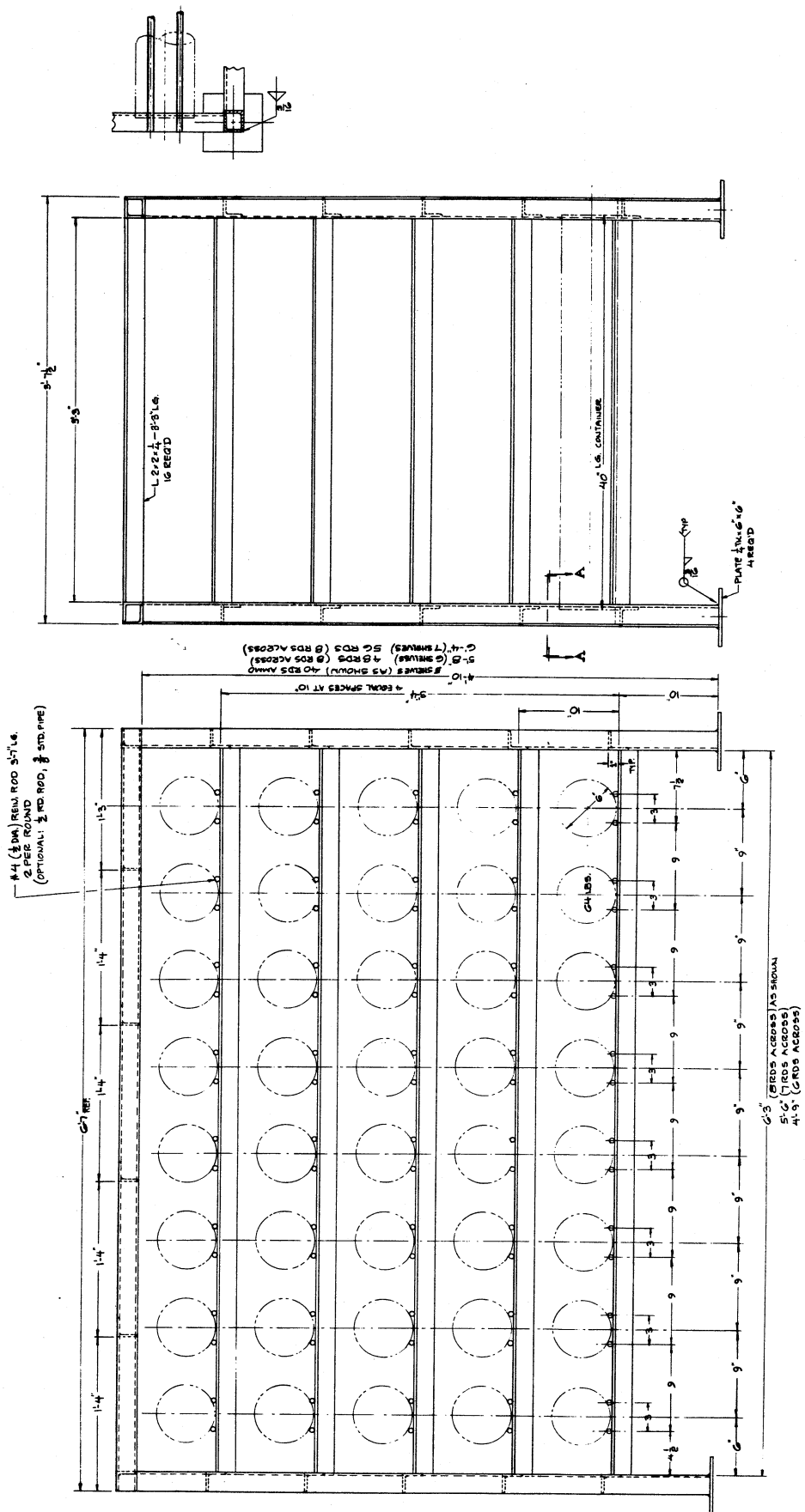
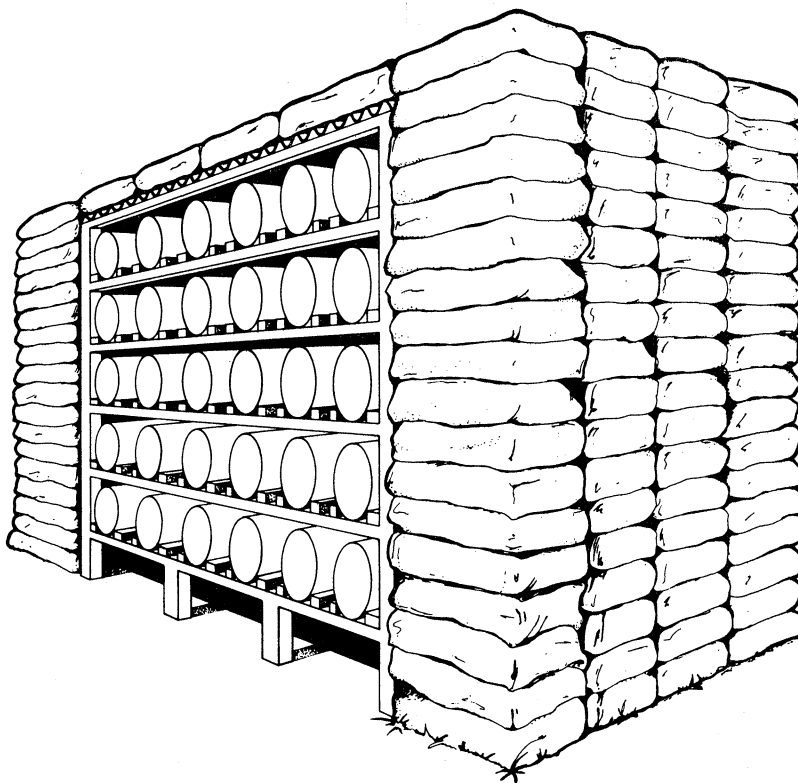


Figure 1. Rack

(a)



(b)

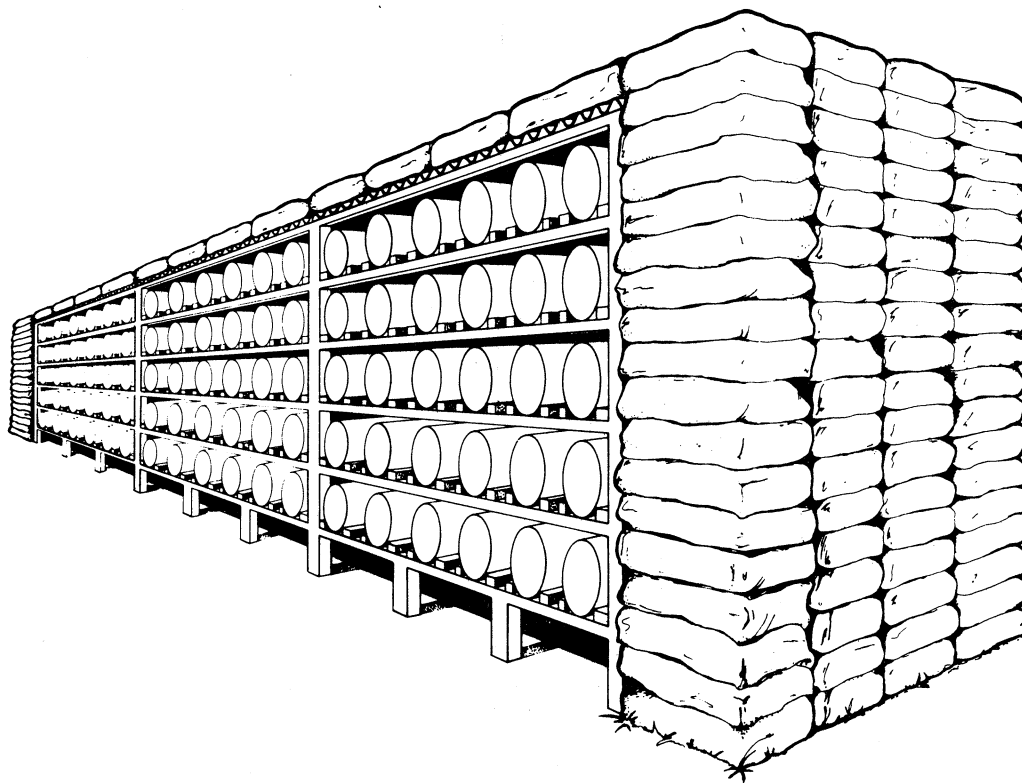


Figure 2. (a) Rack with Sand Covers and Side Barriers in Place.  
(b) Several Collocated Racks.

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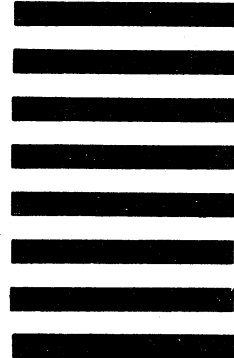


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